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EXAMINER	
PATEL, ISHWARBHAI B	

ART UNIT	PAPER NUMBER
2841	

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/685,042	CAMERLO ET AL.	
	Examiner	Art Unit	
	Ishwar (I. B.) Patel	2841	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *22 August 2005*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-19 and 25-32* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-19 and 25-32* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *14 October 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☒ Other: *Appendix "A"*.

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims 1-3, 8-9, 11 and 12 are rejected under 35 U.S.C. 102(b) as being anticipated by Natarajan et al., US Patent No. 5,519,580 (Natarajan).

Regarding claim 1, Natarajan, in figure 2, discloses a pad layout for mounting with a circuit board component, the pad layout comprising: a set of pads (set of pads as marked on figure 2 in appendix "A") arranged on a surface of a circuit board in a two-dimensional array having at least two pads in a first direction and at least two pads in a second direction that is substantially perpendicular to the first direction (see figure 2), each pad of the set of pads having (i) a central portion (28, as shown in figure 3 in detail) and (ii) multiple lobe portions (26, as shown in detail in figure 3) integrated with the central portion (28) and extending from the central portion of that pad (see figure 3).

Regarding claim 2, Natarajan further discloses for each pad of the set of pads, that pad has exactly four lobe portions that extend from the central portion of that pad.

Regarding claim 3, Natarajan further discloses for each pad of the set of pads, two of the four lobe portions of that pad extend along a first axis, and another two of the four lobe portions of that pad extend along a second axis that is substantially perpendicular to the first axis (see figure 3, two of the lobs are extend along one (first) axis and the other to extend perpendicular to the first axis).

Regarding claim 8, Natarajan further discloses each pad of the set of the pads substantially has: a first length along a first axis (axis passing between two of the lobes and length along that axis) and the first length along a second axis (axis perpendicular to the first axis and length along that axis) that is substantially perpendicular to the first axis, and a second length along a third axis (second length along the axis passing through the lob) and the second length along a fourth axis (second length along the axis perpendicular to the third axis) that is substantially perpendicular to the third axis, and wherein the second length is greater than the first length (length along the lobe is greater than that of the length along the axis not passing through the lobe, see figure 3).

Regarding claim 9, Natarajan further discloses the first and second axes are pivoted from the third and fourth axes by substantially 45 degrees (axis passing through the lobes is pivoted by 45 degrees than that of not passing through the lobes).

Regarding claim 11, Natarajan in figure 2, discloses a circuit board, comprising: a set of circuit board layers (set of circuit board layers not shown in figure but the

structure of package 10 is with internal routing wires in different layers, column 2, line 53-56) combined to form a rigid planar structure having an outer surface (16); and a pad layout (layout as shown in figure 2) configured to mount with a circuit board component, the pad layout (pad layout as shown in figure 2) including a set of pads (set of pads as marked on figure 2 in appendix "A"), arranged on the surface of a circuit board in a two-dimensional array having at least two pads in a first direction and at least two pads in a second direction that is substantially perpendicular to the first direction (see marked up figure 2 in appendix "A"), each pad of the set of pads having (i) a central portion (28, as shown in figure 3 in detail) and (ii) multiple lobe portions (26, as shown in detail in figure 3) integrated with the central portion and extending from the central portion of that pad.

Regarding claim 12, Natarajan further discloses for each pad of the set of pads, that pad has exactly four lobe portions (26, as shown in detail in figure 3) that extend from the central portion (28) of that pad, two of the four lobe portions of that pad extending along a first axis (axis passing from two of the lobe portions), and another two of the four lobe portions of that pad extending along a second axis (axis passing through the other of the four lobe portions) that is substantially perpendicular to the first axis.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claim 4, 5, 10, 13 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Natarajan as applied to claims 1 and 11 above, and further in view of Darveaux et al., US Patent No. 6,201,305 (Darveaux).

Regarding claim 4, Natarajan discloses all the features of the claimed invention as applied to claim 1 above, including each pad of the set of pads has a profile having multiple outer radii as shown in detail in figure 3, but does not disclose the multiple outer radii of substantially 3 mils.

Darveaux discloses pads with multiple outer radii as shown in figure 3A and 4A and further recites that the central pad and lobes (spokes 32) can vary widely depending upon the particular application at hand (column 6, line 32-42), to have better shear performance, ball thermal cycle reliability, ball attach yield, and ball positional tolerance (column 4, line 28-34).

Further, it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of applicant's invention to provide the pads with profile having multiple outer radii of substantially 3 mils, as taught by in order to have better shear performance, ball thermal cycle reliability, ball attach yield, and ball positional tolerance.

Regarding claim 5, Natarajan discloses all the features of the claimed invention as applied to claim 4 above, but does not disclose the profile of each pad of the set of pads further has multiple concave radii of substantially 8 mils.

Darveaux discloses pads with multiple out radii and multiple concave radii, as shown in figure 3A and 4A and further recites that the central pad and lobes (spokes 32) can vary widely depending upon the particular application at hand (column 6, line 32-42), to have better shear performance, ball thermal cycle reliability, ball attach yield, and ball positional tolerance (column 4, line 28-34).

Further, it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of applicant's invention to provide each pad of Natarajan with profile having multiple concave radii of substantially 8 mils, as taught by Darveaux in order to have better shear performance, ball thermal cycle reliability, ball attach yield, and ball positional tolerance.

Regarding claim 10, Natarajan discloses all the features of the claimed invention as applied to claim 8 above, but does not disclose the first length is substantially 18 mils and the second length is substantially 24 mils.

Darveaux discloses pads with multiple outer radii and multiple concave radii, as shown in figure 3A and 4A and further recites that the central pad and lobes (spokes 32) can vary widely depending upon the particular application at hand (column 6, line 32-42), to have better shear performance, ball thermal cycle reliability, ball attach yield, and ball positional tolerance (column 4, line 28-34).

Further, it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of applicant's invention to provide pads of Natarajan with the first length substantially 18 mils and the second length is substantially 24 mils, as taught by Darveaux, in order to have better shear performance, ball thermal cycle reliability, ball attach yield, and ball positional tolerance.

Regarding claim 13, Natarajan discloses all the features of the claimed invention as applied to claim 11 above, but does not disclose each pad of the set of pads has a profile having multiple outer radii of substantially 3 mils, and multiple concave radii of substantially 8 mils.

Darveaux discloses pads with multiple outer radii and multiple concave radii, as shown in figure 3A and 4A and further recites that the central pad and lobes (spokes 32) can vary widely depending upon the particular application at hand (column 6, line 32-42), to have better shear performance, ball thermal cycle reliability, ball attach yield, and ball positional tolerance (column 4, line 28-34).

Further, it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of applicant's invention to provide pads of Natarajan with each pad of the set of pads has a profile having multiple outer radii of substantially 3 mils, and multiple concave radii of substantially 8 mils, as taught by Darveaux in order to have better shear performance, ball thermal cycle reliability, ball attach yield, and ball positional tolerance.

Regarding claim 15, Natarajan discloses all the features of the claimed invention as applied to claim 11 above, including each pad of the set of pads substantially has: a first length along a first axis (axis passing between two of the lobes and length along that axis) and the first length along a second axis (axis perpendicular to the first axis and length along that axis) that is substantially perpendicular to the first axis, and a second length along a third axis (second length along the axis passing through the lob) and the second length along a fourth axis (second length along the

axis perpendicular to the third axis) that is substantially perpendicular to the third axis; and wherein the first and second axes are pivoted from the third and fourth axes by substantially 45 degrees (axis passing through the lobes is pivoted by 45 degrees than that of not passing through the lobes), but does not disclose the first length is **substantially** 18 mils, and wherein the second length is substantially 24 mils.

Darveaux discloses pads with multiple outer radii and multiple concave radii, as shown in figure 3A and 4A and further recites that the central pad and lobes (spokes 32) can vary widely depending upon the particular application at hand (column 6, line 32-42), to have better shear performance, ball thermal cycle reliability, ball attach yield, and ball positional tolerance (column 4, line 28-34).

Further, it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of applicant's invention to provide pads of Natarajan with the first length substantially 18 mils and the second length is substantially 24 mils, as taught by Darveaux in order to have better shear performance, ball thermal cycle reliability, ball attach yield, and ball positional tolerance.

5. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Natarajan as applied to claim 1 above, and further in view of Wu, (US Patent Application Publication No. 2002/0071935).

Regarding claim 6, Natarajan discloses all the features of the claimed invention as applied to claim 1 above, including solder mask (32) on the surface of the circuit board, having a central aperture portion but does not disclose the solder mask having multiple lobe aperture portions integrated with the central aperture portion to mirror a profile of a corresponding pad.

Natarajan discloses mask with aperture which fully exposes the central portion of corresponding pad and partly covering the lobe portion of the corresponding pad, (figure 3).

Wu, in figure 6A and 8, discloses a non solder mask defined pad structure with mask having central aperture and further having multiple lobe aperture portions (ditch like grooves) integrated with the central aperture portion to mirror a profile of a corresponding pad. Wu further recites that because of such design, the contact area between the solder paste and solder pad is expanded. Hence when doing the reflow process, the adhesion force will be greatly increased (page 1, paragraph 0008).

A person of ordinary skill in the art at the time of applicant's invention would have recognized the advantage of providing non solder mask defined pad structure with the solder mask having multiple lobe aperture portions in order to increase the contact area between the solder paste and solder pad to increase the adhesion force during solder reflow process.

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of applicant's invention to provide the solder mask around the pad of Natarajan, having multiple lobe aperture portions integrated with the central aperture portion to

mirror a profile of a corresponding pad, as taught by Wu, in order to increase the contact area between the solder paste and solder pad to increase the adhesion force during solder reflow process.

6. Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over the modified structure of Natarajan, as applied to claims 1and 6 above, and further in view of Fukasawa, US Patent No. 5,844,782.

Regarding claim 7, the modified structure of Natarajan, discloses all the features of the claimed invention including the clearance regions defined by the solder mask as applied to claim 6 above, but does not disclose clearance regions are substantially 2 mils wide around each pad of the set of pads.

Fukasawa, in figure 3A, discloses a solder mask (pattern protecting film 17) around the pad having a clearance of about 2 mils (gap of 0.05 mm, column 3, line 30) and further recites that "(e)ven when a temperature cycles test or the like is carried out, the external electrode 13 and the pattern protecting film 17, the thermal expansion coefficients of which are greatly different, are kept out of contact with each other and consequently thermal stresses do not act in the base portions of the eternal electrodes 13 as has happened in devices of the related art of this kind".

Further, it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of applicant's invention to provide the modified solder mask opening of the Natarajan, with a clearance regions substantially 2 mils wide around each pad of the set of pads, as taught by Fukasawa, in order to avoid contacting the mask to the solder on the pad causing thermal stresses.

7. Claim 14 rejected under 35 U.S.C. 103(a) as being unpatentable over Natarajan as applied to claim 11 above, and further in view of Wu, US Patent Application Publication No. 2002/0071935 and Fukasawa, US Patent No. 5,844,782.

Regarding claim 14, Natarajan discloses all the features of the claimed invention as applied to claim 11 above, including solder mask (32) on the surface of the circuit board, having a central aperture portion but does not disclose **the solder mask having multiple lobe aperture portions integrated with the central aperture portion to mirror a profile of a corresponding pad and the solder mask further defining clearance regions that are substantially 2 mils wide around each pad of the set of pads**.

Natarajan et al., discloses mask with aperture which fully exposes the central portion of corresponding pad and partly covering the lobe portion of the corresponding pad, (figure 3).

Wu, in figure 6A and 8, discloses a non solder mask defined pad structure with mask having central aperture and further having multiple lobe aperture portions (ditch like groove) integrated with the central aperture portion to mirror a profile of a

corresponding pad. Wu further recites that because of such design, the contact area between the solder paste and solder pad is expanded. Hence when doing the reflow process, the adhesion force will be greatly increased (page 1, paragraph 0008).

A person of ordinary skill in the art at the time of applicant's invention would have recognized the advantage of providing non solder mask defined pad structure with the solder mask having multiple lobe aperture portions in order to increase the contact area between the solder paste and solder pad to increase the adhesion force during solder reflow process.

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of applicant's invention to provide the solder mask around the pad of Natarajan, having multiple lobe aperture portions integrated with the central aperture portion to mirror a profile of a corresponding pad, as taught by Wu, in order to increase the contact area between the solder paste and solder pad to increase the adhesion force during solder reflow process.

Further, Fukasawa, in figure 3A, discloses a solder mask (pattern protecting film 17) around the pad having a clearance of about 2 mils (gap of 0.05 mm, column 3, line 30) and further recites that "(e)ven when a temperature cycles test or the like is carried out, the external electrode 13 and the pattern protecting film 17, the thermal expansion coefficients of which are greatly different, are kept out of contact with each other and consequently thermal stresses do not act in the base portions of the eternal electrodes 13 as has happened in devices of the related art of this kind".

Furthermore, it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of applicant's invention to provide the modified solder mask opening of the Natarajan, with a clearance regions substantially 2 mils wide around each pad of the set of pads, as taught by Fukasawa, in order to avoid contacting the mask to the solder on the pad causing thermal stresses.

8. Claims 16, 18 and 19 rejected under 35 U.S.C. 103(a) as being unpatentable over Forehand et al., US Patent No. 5,847,936 (Forehand) and further in view of Natarajan et al., US Patent No. 5,519,580 (Natarajan).

Regarding claim 16, Forehand, in figure 3, discloses a circuit board assembly, comprising: a set of circuit board layers (231-235) combined to form a rigid planar structure (printed circuit board 220) having an outer surface (outer surface of the board); a pad layout (pad layout as shown in figure 5) including a set of pads arranged on the surface of a circuit board in a two-dimensional array having at least two pads in a first direction and at least two pads in a second direction that is substantially perpendicular to the first direction (pad pattern 401, shown in detail in figure 5), a circuit board component (integrated circuit 201, column 2, line 45-50) mounted to the pad layout via a set of solder joints (219).

Forehand et al., does not disclose each pad of the set of pads having (i) a central portion (26, as shown in detail in figure 3) and (ii) multiple lobe portions (26, as shown in detail in figure 3) integrated with the central portion and extending from the central portion of that pad.

Natarajan, in figure 1 discloses a package substrate with pad layout (shown in detail in figure 2) and further discloses pads having (i) a central portion (26, as shown in detail in figure 3) and (ii) multiple lobe portions (26, as shown in detail in figure 3) integrated with the central portion and extending from the central portion of that pad, in order to have an uniform and robust solder joints (column 1, line 50).

A person of ordinary skill in the art would have recognized the advantages of providing lobes on the pad in order to have uniform and robust solder joints.

Therefore, it would have been obvious to a person of ordinary skill in the art to modify the pads structure of the circuit board of Forehand, to have lobes as taught by Natarajan, in order to have an uniform and robust solder joints.

Regarding claim 18, the modified circuit board assembly of Forehand, further discloses the circuit board component includes ball grid array package having a set of ball-shaped (219) contacts corresponding to the set of pads.

Regarding claim 19, Forehand, in figure 3, discloses a circuit board assembly, comprising: a set of circuit board layers (231-235) combined to form a rigid planar structure (printed circuit board 220) having an outer surface (outer surface of the board);

a pad layout (pad layout as shown in figure 5) including a set of pads arranged on the surface of a circuit board in a two-dimensional array having at least two pads in a first direction and at least two pads in a second direction that is substantially perpendicular to the first direction (pad pattern 401, shown in detail in figure 5), a circuit board component (integrated circuit 201, column 2, line 45-50), means (solder ball 219) for mounting the circuit board component to the set of pads of the pad layout.

Forehand et al., does not disclose each pad of the set of pads having (i) a central portion and (ii) multiple lobe portions integrated with the central portion and extending from the central portion of that pad.

Natarajan, in figure 1 discloses a package substrate with pad layout (shown in detail in figure 2) and further discloses pads having (i) a central portion (26, as shown in detail in figure 3) and (ii) multiple lobe portions (26, as shown in detail in figure 3) integrated with the central portion and extending from the central portion of that pad, in order to have an uniform and robust solder joints (column 1, line 50).

A person of ordinary skill in the art would have recognized the advantages of providing lobes on the pad in order to have uniform and robust solder joints.

Therefore, it would have been obvious to a person of ordinary skill in the art to modify the pads structure of the circuit board of Forehand et al., to have lobes as taught by Natarajan, in order to have an uniform and robust solder joints.

9. Claim 31 rejected under 35 U.S.C. 103(a) as being unpatentable over the modified board of Forehand (in combination of Natarajan) as applied to claim 19 above, and further in view of Kusui, US Patent No. 6,441,316.

Regarding claim 31, the modified circuit board of Forehand discloses all the features of the claimed invention, including the integrated circuit package, as applied to claim 19 above, but does not disclose a solder paste on the pads. However, providing solder paste on the pad in order better solder connection is known in the art. Kusui, in figure 3 and 4, disclose a printed circuit board (1) with pads 2, having solder paste (10, column 4,line 23-25).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of applicant's invention to provide the pad of the modified circuit board of Forehand with solder paste, as taught by Kusui, in order to have better connection.

10. Claim 32 is rejected under 35 U.S.C. 103(a) as being unpatentable over the modified board of Forehand (in combination with Natarajan and Kusui), as applied to claim 19 above, and further in view of Darveaux et al. US Patent No. 6,201,305 (Darveaux).

Regarding claim 32, the modified circuit board of Forehand discloses all the features of the claimed invention, including each pad of the set of pads with lobes with convex relative to center of the pad, (Natarajan, figure 3) and central portion, as applied to claims 19 and 32 above, but does not disclose the central portion with edges in

concave shape relative to center of that pad and the distally disposed edges and central portion edges blend smoothly in a manner that is free of sharp angled intersection and each concave edges has a radius which is at least twice as large in value as every convex edge.

Darveaux, in figure 4A, discloses a pad with distal end of the lobe with a convex shape and edge of the central portion with concave edges with the distally disposed edges and the central portion edges blend smoothly in a manner that is free of sharp angled inter section. Darveaux further recites that the central pad and lobes (spokes 32) can vary widely depending upon the particular application at hand (column 6, line 32-42), to have better shear performance, ball thermal cycle reliability, ball attach yield, and ball positional tolerance (column 4, line 28-34).

Further, it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of applicant's invention to further modify the modified pads of the board of Forehand with the central portion with edges in concave shape relative to center of that pad and the distally disposed edges and central portion edges blend smoothly in a manner that is free of sharp angled intersection and each concave edges has a radius which is at least twice as large in value as every convex edge, as taught by Darveaux, in order to have better shear performance, ball thermal cycle reliability, ball attach yield, and ball positional tolerance.

11. Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over the modified circuit board assembly of Forehand (in combination of Natarajan) as applied to claim 16 above, and further in view of Katchmar, US Patent No. 6,194,782.

Regarding claim 17, the modified circuit board assembly of Forehand, discloses all the feature of the claimed invention as applied to claim 16 above, but does not disclose the circuit board component includes a ceramic column grid array package having a set of column-shaped contacts corresponding to the set of pads.

Katchmar discloses that integrated circuit packages to area array packages, both the ball grid array package (as shown in figure 4, 5 and 6) and ceramic column grid array package (as shown in figure 7) installed on circuit board (substrate 28), are known in the art, in order to have large number of interconnection between the package and the substrate, column 1, line 5-24.

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of applicant's invention to provide the modified circuit board assembly of Forehand, with the circuit board component including a ceramic column grid array package having a set of column-shaped contacts corresponding to the set of pads, as taught by Katchmar, in order to have desired large number of interconnection between the package and the substrate.

12. Claim 29 rejected under 35 U.S.C. 103(a) as being unpatentable over the modified board of Forehand (in combination of Natarajan) as applied to claim 16 above, and further in view of Kusui, US Patent No. 6,441,316.

Regarding claim 29, the modified circuit board of Forehand discloses all the features of the claimed invention, including the integrated circuit package, as applied to claim 16 above, but does not disclose a solder paste on the pads. However, providing solder paste on the pad in order better solder connection is known in the art. Kusui, in figure 3 and 4, disclose a printed circuit board (1) with pads 2, having solder paste (10, column 4,line 23-25).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of applicant's invention to provide the pad of the modified circuit board of Forehand with solder paste, as taught by Kusui, in order to have better connection.

13. Claim 30 is rejected under 35 U.S.C. 103(a) as being unpatentable over the modified board of Forehand (in combination with Natarajan and Kusui), as applied to claim 29 above, and further in view of Darveaux et al. US Patent No. 6,201,305 (Darveaux).

Regarding claim 26, the modified circuit board of Forehand discloses all the features of the claimed invention, including each pad of the set of pads with lobes with convex relative to center of the pad, (Natarajan, figure 3) and central portion, as applied to claims 16 and 29 above, but does not disclose the central portion with edges in

concave shape relative to center of that pad and the distally disposed edges and central portion edges blend smoothly in a manner that is free of sharp angled intersection and each concave edges has a radius which is at least twice as large in value as every convex edge.

Darveaux, in figure 4A, discloses a pad with distal end of the lobe with a convex shape and edge of the central portion with concave edges with the distally disposed edges and the central portion edges bled smoothly in a manner that is free of sharp angled inter section. Darveaux further recites that the central pad and lobes (spokes 32) can vary widely depending upon the particular application at hand (column 6, line 32-42), to have better shear performance, ball thermal cycle reliability, ball attach yield, and ball positional tolerance (column 4, line 28-34).

Further, it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of applicant's invention to further modify the modified pads of the board of Forehand with the central portion with edges in concave shape relative to center of that pad and the distally disposed edges and central portion edges blend smoothly in a manner that is free of sharp angled intersection and each concave edges has a radius which is at least twice as large in value as every convex edge, as taught by Darveaux, in order to have better shear performance, ball thermal cycle reliability, ball attach yield, and ball positional tolerance.

14. Claims 1 is rejected under 35 U.S.C. 103(a) as being unpatentable over Forehand et al., US Patent No. 5,847,936 (Forehand) and further in view of Natarajan et al., US Patent No. 5,519,580 (Natarajan).

Regarding claim 1, Forehand, in figure 5, discloses a pad layout for mounting with a circuit board component, the pad layout comprising: a set of pads (pad pattern 401) arranged on a surface of a circuit board (220) in a two-dimensional array having at least two pads in a first direction and at least two pads in a second direction that is substantially perpendicular to the first direction (pad patterns 401).

Forehand et al., does not disclose each pad of the set of pads having (i) a central portion and (ii) multiple lobe portions integrated with the central portion and extending from the central portion of that pad.

Natarajan, in figure 1 discloses a package substrate with pad layout (shown in detail in figure 2) and further discloses pads having (i) a central portion (26, as shown in detail in figure 3) and (ii) multiple lobe portions (26, as shown in detail in figure 3) integrated with the central portion and extending from the central portion of that pad, in order to have an uniform and robust solder joints (column 1, line 50).

A person of ordinary skill in the art would have recognized the advantages of providing lobes on the pad in order to have uniform and robust solder joints.

Therefore, it would have been obvious to a person of ordinary skill in the art to modify the pads structure of the circuit board of Forehand, to have lobes as taught by Natarajan, in order to have an uniform and robust solder joints.

15. Claims 25 rejected under 35 U.S.C. 103(a) as being unpatentable over the modified board of Forehand (in combination of Natarajan) as applied to claim 1 above, and further in view of Kusui, US Patent No. 6,441,316.

Regarding claim 25, the modified circuit board of Forehand discloses all the features of the claimed invention, including the integrated circuit package, as applied to claim 1 above, but does not disclose a solder paste on the pads. However, providing solder paste on the pad in order better solder connection is known in the art. Kusui, in figure 3 and 4, disclose a printed circuit board (1) with pads 2, having solder paste (10, column 4,line 23-25).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of applicant's invention to provide the pad of the modified circuit board of Forehand with solder paste, as taught by Kusui, in order to have better connection.

16. Claim 26 is rejected under 35 U.S.C. 103(a) as being unpatentable over the modified board of Forehand (in combination with Natarajan and Kusui), as applied to claim 25 above, and further in view of Darveaux et al. US Patent No. 6,201,305 (Darveaux).

Regarding claim 26, the modified circuit board of Forehand discloses all the features of the claimed invention, including each pad of the set of pads with lobes with convex relative to center of the pad, (Natarajan, figure 3) and central portion, as applied to claims 1 and 25 above, but does not disclose the central portion with edges in concave shape relative to center of that pad and the distally disposed edges and central portion edges blend smoothly in a manner that is free of sharp angled intersection and each concave edges has a radius which is at least twice as large in value as every convex edge.

Darveaux, in figure 4A, discloses a pad with distal end of the lobe with a convex shape and edge of the central portion with concave edges with the distally disposed edges and the central portion edges bled smoothly in a manner that is free of sharp angled inter section. Darveaux further recites that the central pad and lobes (spokes 32) can vary widely depending upon the particular application at hand (column 6, line 32-42), to have better shear performance, ball thermal cycle reliability, ball attach yield, and ball positional tolerance (column 4, line 28-34).

Further, it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of applicant's invention to further modify the modified pads of the board of Forehand with the central portion with edges in concave shape relative to center of that

pad and the distally disposed edges and central portion edges blend smoothly in a manner that is free of sharp angled intersection and each concave edges has a radius which is at least twice as large in value as every convex edge, as taught by Darveaux, in order to have better shear performance, ball thermal cycle reliability, ball attach yield, and ball positional tolerance.

17. Claim 11 is rejected under 35 U.S.C. 103(a) as being unpatentable over Forehand et al., US Patent No. 5,847,936 (Forehand) and further in view of Natarajan et al., US Patent No. 5,519,580 (Natarajan).

Regarding claim 11, Forehand, in figure 5, discloses a circuit board, comprising: a set of circuit board layers (231-235) combined to form a rigid planar structure (printed circuit board 220) having an outer surface (outer surface of the board); and a pad layout (layout as shown in figure 5) configured to mount with a circuit board component, the pad layout including a set of pads (401), arranged on the surface of a circuit board in a two-dimensional array having at least two pads in a first direction and at least two pads in a second direction that is substantially perpendicular to the first direction (pad layout shown in figure 5).

Forehand et al., does not disclose each pad of the set of pads having (i) a central portion and (ii) multiple lobe portions integrated with the central portion and extending from the central portion of that pad.

Forehand et al., does not disclose each pad of the set of pads having (i) a central portion and (ii) multiple lobe portions integrated with the central portion and extending from the central portion of that pad.

Natarajan, in figure 1 discloses a package substrate with pad layout (shown in detail in figure 2) and further discloses pads having (i) a central portion (26, as shown in detail in figure 3) and (ii) multiple lobe portions (26, as shown in detail in figure 3) integrated with the central portion and extending from the central portion of that pad, in order to have an uniform and robust solder joints (column 1, line 50).

A person of ordinary skill in the art would have recognized the advantages of providing lobes on the pad in order to have uniform and robust solder joints.

Therefore, it would have been obvious to a person of ordinary skill in the art to modify the pads structure of the circuit board of Forehand, to have lobes as taught by Natarajan, in order to have an uniform and robust solder joints.

18. Claims 27 rejected under 35 U.S.C. 103(a) as being unpatentable over the modified board of Forehand (in combination of Natarajan) as applied to claim 11 above, and further in view of Kusui, US Patent No. 6,441,316.

Regarding claim 27, the modified circuit board of Forehand discloses all the features of the claimed invention, including the integrated circuit package, as applied to claim 1 above, but does not disclose a solder paste on the pads. However, providing

solder paste on the pad in order better solder connection is known in the art. Kusui, in figure 3 and 4, disclose a printed circuit board (1) with pads 2, having solder paste (10, column 4,line 23-25).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of applicant's invention to provide the pad of the modified circuit board of Forehand with solder paste, as taught by Kusui, in order to have better connection.

19. Claim 28 is rejected under 35 U.S.C. 103(a) as being unpatentable over the modified board of Forehand (in combination with Natarajan and Kusui), as applied to claim 27 above, and further in view of Darveaux et al. US Patent No. 6,201,305 (Darveaux).

Regarding claim 28, the modified circuit board of Forehand discloses all the features of the claimed invention, including each pad of the set of pads with lobes with convex relative to center of the pad, (Natarajan, figure 3) and central portion, as applied to claims 11 and 27 above, but does not disclose the central portion with edges in concave shape relative to center of that pad and the distally disposed edges and central portion edges blend smoothly in a manner that is free of sharp angled intersection and each concave edges has a radius which is at least twice as large in value as every convex edge.

Darveaux, in figure 4A, discloses a pad with distal end of the lobe with a convex shape and edge of the central portion with concave edges with the distally disposed edges and the central portion edges bled smoothly in a manner that is free of sharp

angled inter section. Darveaux further recites that the central pad and lobes (spokes 32) can vary widely depending upon the particular application at hand (column 6, line 32-42), to have better shear performance, ball thermal cycle reliability, ball attach yield, and ball positional tolerance (column 4, line 28-34).

Further, it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of applicant's invention to further modify the modified pads of the board of Forehand with the central portion with edges in concave shape relative to center of that pad and the distally disposed edges and central portion edges blend smoothly in a manner that is free of sharp angled intersection and each concave edges has a radius which is at least twice as large in value as every convex edge, as taught by Darveaux, in order to have better shear performance, ball thermal cycle reliability, ball attach yield, and ball positional tolerance.

Response to Arguments

20. Applicant's arguments filed August 22, 2005 have been fully considered but they are not persuasive.

Claims 1-10:

Applicant argues that Natarajan does not teach or suggest a pad layout for mounting with a circuit board component, where the pad layout includes a set of pad arranged on a surface of a circuit board. This is not found to be correct.

First, claim 1 is directed to a **pad layout** comprising a set of pads arranged on a surface of a circuit board. Natarajan, teaches a package body (10) with solder pads, via and internal wiring, column 2, line 50-56. The body with solder pads, via hole and internal wiring is circuit board and the pad layout as claimed is shown on the bottom surface of the body. The recitation "for mounting with a circuit board component" is in the preamble and has not been given patentable weight because it has been held that a preamble is denied the effect of a limitation where the claim is drawn to a structure and the portion of the claim following the preamble is a self contained description of the structure not depending for the completeness upon the introductory clause. Kropa v. Robie, 88 USPQ 478 (CCPA 1951).

Regarding the dependent claims (claims depending upon claim 1), the applicant argues (page 13) that secondary art of Darveaux does not teaches or suggest features of any radii, in specific the pads with outer radii of **substantially** 3 mil and concave radius of **substantially** 8 mils, and further states that none of the other cited reference provide such a disclosure. This is not found persuasive.

The examiner recognizes that references cannot be arbitrarily combined and that there must be some reason why one skilled in the art would be motivated to make the proposed combination of primary and secondary references. *In re Nomiya*, 184 USPQ 607 (CCPA 1975). However there is no requirement that a motivation to make the

modification be expressly articulated. The test for combining references is what the combination of disclosures taken as a whole would suggest to one of ordinary skill in the art. *In re Simon*, 174 USPQ 114 (CCPA 1972); *In re McLaughlin*, 170 USPQ 209 (CCPA 1971). The secondary art of Darveaux, in figure 4A, discloses multiple outer radii and multiple concave radii and further recites that the dimensions can vary **widely** depending upon the particular application at hand (Darveaux, column 6, line 32-42). The radii will vary in relation to the width of the spokes and the diameter of the central portion.

Further, in response to applicant's piecemeal analysis of the references, it has been held that one cannot show non-obviousness by attacking references individually where, as here, the rejections are based on combination of references. *In re Keller*, 208 USPQ 871 (CCPA 1981).

Claims 11-15:

Similar arguments, as that for claims 1-10, are there for claims 11-15 and explanation as given above is applicable and has not been repeated.

Claims 16-18:

Similar arguments, as that for claims 1-10, are there for claims 16 and dependent claims, stating that Natarajan does not discloses the detail as claimed and the rejection under 35 U. S. C. §102(b) should be withdrawn. However, it is to be noted that the claim 16 is not rejected under 35 U. S. C. §102(b). Claim 16 is rejected under 35 U. S. C.

§103(a), with a prior art of Forehand as a primary reference and the prior art of Natarajan as a secondary reference for the teachings of the shape of the pads.

Claims 19:

Similar arguments, as that for claims 1-10, are there for claims 19, stating that Natarajan does not discloses the detail as claimed and the rejection under 35 U. S. C. §102(b) should be withdrawn. However, it is to be noted that the claim 16 is not rejected under 35 U. S. C. §102(b). Claim 16 is rejected under 35 U. S. C. §103(a), with a prior art of Forehand as a primary reference and the prior art of Natarajan as a secondary art for the teachings of the shape of the pads.

Conclusion

21. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

It is to be noted that additional new ground of rejection for claims 1 and 11 is given in view of addition of new claims.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ishwar (I. B.) Patel whose telephone number is (571) 272 1933. The examiner can normally be reached on M-F (8:30 - 5:00).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kamand Cuneo can be reached on (571) 272 1957. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

IBPatel

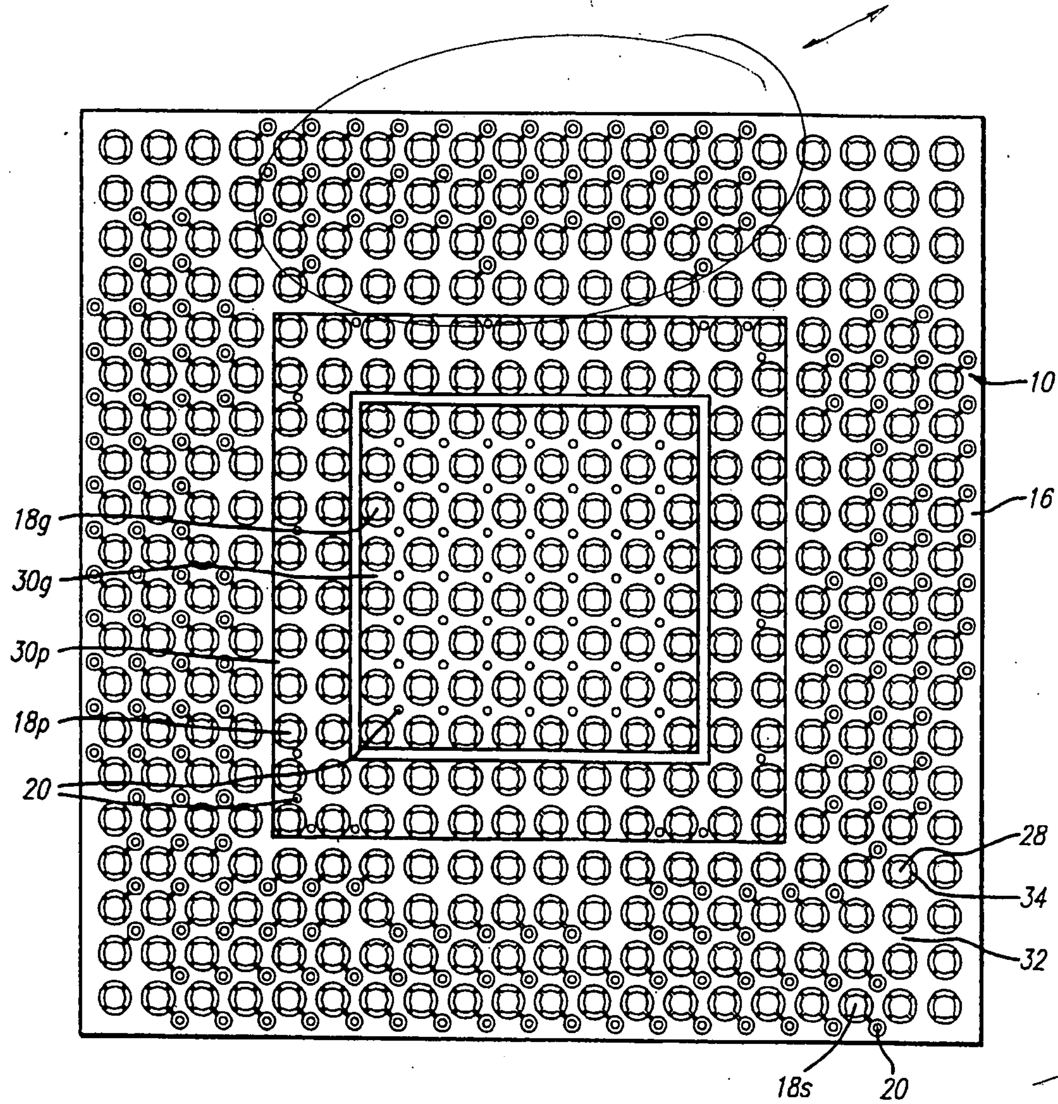
Ishwar (I. B.) Patel
Examiner
Art Unit: 2841
October 29, 2005.

Appendise "A"

application # 10/68504

FIG. 2

SET OF PADS



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